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CENTER FOR RADIOPHYSICS AND SPACE RESEARCH
CORNELL UNIVERSITY
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CRSR 174

FINAL STATUS REPORT

to

National Aeronautics and Space Administration

on

Four Ferrite Core Magnetometers

NASA Contract NASr-46

October 1, 1963 through May 15, 1964

I. INTRODUCTION

NASA Contract NASr-46 required the fabrication of four (4) single component magnetometers complete with electronics and the preparation of a manual covering their design and operation. The four magnetometers have been completed and will be sent to NASA upon receipt of shipping instructions. The manual has been completed and issued separately as CRSR Report 172. Section II includes the final status report and Section III lists the personnel who were associated with the project.

II. FINAL REPORT ON EXTENDED PORTION OF NASr-46

Four single component magnetometers have been made using the new drive design. Their drift and noise is within $\pm 0.3\gamma$ (± 3 microgauss) or better, with ± 1.5 v analog readout range. Input power requirements have been reduced from 1.5 watts in previous models to 0.58 - 0.9 watt at 20 - 25v DC input. At close to zero field sensitivity is 0.2 - 0.5mv per ambient gamma. Probing of circuitry is facilitated by the spreading out of component parts. Thus, not being potted, the models as completed require some care in handling.

A. Electronics Parts Layout

In the operating range of 5 - 10KC both electrostatic and magnetic coupling can occur in adjacent open circuitry but are minimized by careful layout of critical components. The input amplifier and signal filter should ordinarily be potted in permalloy shielded cans for optimum results. However, to maintain full accessability some coupling and the accompanying deleterious effects had to be tolerated.

B. Zero Output Adjustment

Adequately close determination of zero field indicating accuracy requires repeated turnover of the sensor to separate the magnetic drift and noise of the facility from the drift and noise of the instrument under test. In the small working volume of a closed flux can turnover results are limited in precision by internal field gradients, the inevitable consequence of field adjustment during use. Therefore final setting of the demodulator diode bridge for best zero field indicating accuracy should be done in a low magnetic noise and gradient zero field facility.

C. Noise and Drift Level Determination

The component of the ambient magnetic field parallel to the sensor must be lower in noise and drift than the sensor and associated electronics in order to conveniently measure the noise and drift of the magnetometer. A flux can ordinarily is used with internal coils energized from regulated DC sources to compensate for that portion of the earth's field which penetrates to the sensor. If the acquired perm of the nest of permalloy shields is to be cancelled via a power supply then the drift and noise of the supply itself will be added to that of the magnetometer and become quite apparent. And if internal field gradients make turnover checking of little value at the low levels of interest an experimenter may well find himself measuring the drift and noise of his field setting power supply instead of his magnetometer.

Our method was simply to invest the can with a perm equal but of opposite sign to that from the penetrating portion of the earth's field, and to wait for the drift in perm to recede to negligible proportions. If a capacitor discharge is used for controlled perming the magnetic transient will be too fast for the sensor's negative magnetic feedback system. The head then should be depermed by a five or ten second interruption of the magnetometer's power supply to initiate automatic sensor ringdown.

D. Manual

A manual was written describing the design and operation of the circuitry. This has been issued as a separate document, CRSR 172. Copies have been furnished to NASA and are also included with each magnetometer.

E. Conclusion

The purpose for extension of the NASr-46 contract was that various groups within NASA concerned with space magnetometry may be able to examine and test the new ferrite sensing head. Therefore, four single component magnetometers have been made. A new drive system with reliably lower even harmonic contamination was devised facilitating improved zero field indicating reliability. A high purity automatic sensor deperming circuit that operates each time a power source interruption of more than several seconds occurs was also included. The power required for operation has been cut on the average by one half. A manual discussing the design and operation of the circuitry was written and areas where significant improvements might be made were suggested.

III. PERSONNEL

The following personnel were associated with the NASA Contract NASr-46 during the period of this report.

Prof. Thomas Gold, Project Supervisor, part time, (no charge to the contract)

H. J. Eckelmann, Research Associate, part time

E. N. Armbruster, Technician, part time

R. P. DeBell, Machinist, part time.

7/27/64
Date

T. Gold, Director, CRSR

IV. REFERENCES

Manual for Fluxgate Ferrite Magnetometer, CRSR 172, July 10, 1964

Quarterly Status Report to the National Aeronautics and Space Administration, Space Magnetometer Development, March 1, 1963 - June 1, 1963, CRSR 124

Final Test Report to the National Aeronautics and Space Administration, Space Magnetometer Development, CRSR 141, May, 1963